The development of TNA

The TNA is a recent revision of the terminology on the Central Nervous System (CNS; Systema nervosum centrale), the Peripheral Nervous System (PNS; Systema nervosum periphericum) and the Sense Organs (Organa sensuum). These were abstracted from the Terminologia Anatomica (1998) and the Terminologia Histologica (2008) and were extensively updated by the FIPAT Working Group Neuroanatomy, and merged to form a Terminologia Neuroanatomica (TNA), representing about 40 % of the Terminologia Anatomica. Because of its clinical and functional significance, the TNA includes the blood supply to the CNS (Vasa sanguinea encephali and Vasa sanguinea medullae spinalis) to ensure it contains a more or less complete list of terms for the human nervous system.

The document is divided into three chapters, see their description below. The official FIPAT terms are in Latin. This enables translation into any vernacular, in the present instance English. The Latin terms have been reviewed by members of the FIPAT Latin Subcommittee. See thereafter the documentation on universal model and translations in the different vernacular.

Chapter 1 : The Central Nervous System

1. Throughout the document, the subdivision of neurons proposed by Bota and Swanson (2007) is used, following the Brain Architecture Management System (BAMS; http://brancusi.usc.edu/bkms) , and including sensory neurons, interneurons (with short or long axons) and motoneurons. The short interneurons are subdivided into excitatory and inhibitory interneurons. The category interneurons with a long axon comprises those interneurons that are usually described as projection, commissural and association neurons.

2. For the white matter tracts, the Foundation Model of Connectivity (Swanson and Bota 2010) is followed for a better presentation. The following subdivision is used: (a) Central roots (radices centrales) for the cranial and spinal nerve roots within the CNS; (b) intrinsic tracts (tractus proprii) remaining within a certain compartment of the CNS such as the spinal cord or the telencephalon; (c) commissural connections (tractus commissurales); and (d) longitudinal tracts (tractus longi) divided into ascending tracts, descending tracts and efferent tracts of the cerebellum.

3. A new section blood vessels is added, a modernized version of the relevant part of the TA Section Systema cardiovasculare. Clinically relevant subdivisions of the arteria carotis interna (C1-C7), arteria cerebri anterior (A1-A5), arteria cerebri media (M1-M4), arteria vertebralis (V1-V4) and arteria cerebri posterior (P1-P4) are added.

4. For the spinal cord, the order of presentation is changed from posterior (dorsal) to anterior (ventral) to be consistent with the presentation of the Rexed layers from I-X, and for consistency with other sections. The known neuron types are added and the white matter is subdivided into central roots, propriospinal tracts and long tracts, ascending and descending.

5. For the brain stem, the various nuclei are rearranged according to their connectivity, following the third edition of Olszewski and Baxter (Büttner-

Ennever and Horn 2014): somatosensory nuclei, viscerosensory nuclei, vestibular nuclei, acustic nuclei, somatomotor nuclei, branchiomotor nuclei, visceromotor nuclei, reticular nuclei, neuromodulatory nuclei (serotonergic, adrenergic, noradrenergic, cholinergic and dopaminergic cell groups), limbic nuclei and precerebellar nuclei. The white matter is subdivided into central roots, intrinsic tracts and long tracts, ascending, descending and cerebellar efferent.

6. For the mesencephalon, the following subdivision is used: pedunculus cerebri (the long corticofugal fibres), tegmentum mesencephali (including the substantia nigra and the ventral tegmental area), substantiae centrales mesencephali and tectum mesencephali.

7. For the cerebellum, the terminology of the lobuli was simplified, the zonal, sagittal organization of corticonuclear projections is introduced and the composition of the cerebellar peduncles is added.

8. A more natural hierarchical classification of brain structures is used for the forebrain (prosencephalon) as implemented in the revised version of the Terminologia Embryologica (TE2). The forebrain is subdivided into the caudal prosencephalon, giving rise to the diencephalon, and a rostral or secondary prosencephalon, giving rise to the hypothalamus and the entire telencephalon. The telencephalon is divided into the pallium and the subpallium (striatum, pallidum, basal forebrain and preoptic area). For practical reasons, the preoptic area is listed following the hypothalamus.

9. The diencephalon in its classic, columnar view was divided into four dorsoventrally arranged columns separated by ventricular sulci: the epithalamus, the dorsal thalamus, the ventral thalamus and the hypothalamus. Extensive embryological studies made it clear that the thalamic 'columns' are derived from transversely oriented zones, the prosomeres (Puelles 2013; TE2). Currently, the diencephalon is subdivided into three segmental units, which from caudal to rostral, contain in their alar domains the pretectum (prosomere 1 or P1), the epithalamus and thalamus (P2) and the ventral thalamus or prethalamus (P3). The diencephalic basal plate (P1-P3) contains the rostral part of the substantia nigra - VTA complex and the interstitial nucleus (nucleus of Cajal), the rostral interstitial nucleus of the medial longitudinal fasciculus, and the elliptic nucleus (nucleus of Darkschewitsch), collectively forming the diencephalic or prerubral tegmentum between the midbrain and the hypothalamus. The entire hypothalamus arises from the alar and basal components of the secondary prosencephalon. The preoptic area is one of the subpallial developmental domains.

10. For the thalamic nuclei, a new subdivision based on Hirai and Jones (1989) and updated by Morel et al. (1997) is introduced. The description of the external features (morphologia externa) of the cerebral hemisphere is extended, including many newly discovered or rediscovered subdivisions. Macroscopically visible olfactory structures are included here. A more extensive discussion of the allocortex is provided.

11. The description of the internal features (morphologia interna) of the cerebral cortex follows the embryological subdivision of the pallium into four parts. The dorsal pallium gives rise to the isocortex or neocortex, the lateral pallium to the claustro-insular complex, the medial pallium to the hippocampal formation and the ventral pallium to the olfactory cortex and the pallial amygdala. Where possible, neuron types are added, starting from the TH terminology. Isocortical neurons are subdivided into pyramidal neurons (projection, commissural and association neurons) and excitatory and inhibitory interneurons. For the inhibitory, mainly GABAergic, interneurons, the Petilla terminology (DeFelipe et al. 2013) is introduced.

12. Under the heading subpallium, the amygdaloid body or complex, the basal forebrain and the basal nuclei (or ganglia) are listed with neuron types and fibre connections.

Chapter 2 : The Peripheral Nervous System

1. All communicating branches that are readily apparent and all those known to have functional significance are included. Any communicating branches that are difficult to demonstrate or have no known function are deleted. The communicating branches are listed as branches of the nerve at their central (proximal) end. Their naming is simplified, eliminating prepositions (ad and cum). To the sympathetic, thoracolumbar part of the autonomic division two additional subsections are added to include other parts of the autonomic division that contain sympathetic neurons and postganglionic sympathetic fibres: (a) the paravertebral ganglia of thorax and abdomen; and (b) perivascular plexuses and their branches that contain postganglionic fibres.

2. The parasympathetic or craniosacral part of the autonomic division includes three subdivisions that contain parasympathetic ganglia and nerve branches that contain parasympathetic fibres to visceral organs: (a) cranial parasympathetic ganglia and their branches; (b) the two vagus trunks and their branches; and (c) the pelvic splanchnic nerves. The pelvic ganglia are replaced under visceral plexuses because they are not classic parasympathetic ganglia.

3. The visceral plexuses include those containing sympathetic and parasympathetic fibres and small ganglia associated with these plexuses. These ganglia were formerly considered parasympathetic ganglia, but have been shown to contain also many neurons that are not classically sympathetic or parasympathetic.

4. The enteric plexus is treated separately because this intramural plexus of the digestive canal is usually considered a nervous system separate from the autonomic or peripheral nervous system: the enteric nervous system (systema nervosum entericum).

Chapter 3 : The Sense Organs

An attempt is made to merge TA and TH terms on the sense organs (organa sensuum). Several clinical experts were involved in this process, including ENT sur-

geons (Matthew Carlson, Mayo Clinic; and later Vedat Topsakal, Brussels, Belgium, and Brandon Isaacson, Dallas, USA) and a neuroophthalmologist (Hans Cruysberg (Nijmegen, The Netherlands). Major changes include a restructuring of the layers of the eye and the classification of sensory neurons.

Acceptance at the 19th IFAA World Congress 2019

The TNA as published on FIPAT's Dalhousie website (http://FIPAT.library.dal.ca) was accepted August 9, 2019 at the 19th IFAA World Congress in London (UK) as the official terminology for the nervous system and the sense organs. Also a Symposium on the TNA was held at the 19th IFAA Meeting.

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